Influence of different bone conduction stimuli in oVEMP testing

- A pilot study of oVEMP and mastoid velocity in two subjects with stimuli at Fz and AFz

Bo Håkansson[1]; Karl-Johan Fredén Jansson[1]; Ian Curthoys[2]; Leigh McGarvie[3]; Luca Veerecchia[4]; Zheer Tawfique[4]; Laura Fröhlich[5]; Julia Dlugaiczyk[6]; Torsten Rahne[7]; Måns Eeg-Olofsson[8]; Sabine Reinfeldt[1]

1. Department of Electrical Engineering, Chalmers University of Technology, Gothenburg, Sweden; 2 Vestibular Research Laboratory, School of Psychology, Faculty of Science, University of Sydney, Sydney, NSW, Australia, 3 Neurology Department, Institute of Clinical Neurosciences, Royal Prince Alfred Hospital, Camperdown, NSW, Australia; 4 Karolinska University Hospital, · Department of Audiology and Neurotology, Stockholm, Sweden; 5. Department of Otorhinolaryngology, University Hospital Bonn, Bonn, Germany, 6 Department of Otorhinolaryngology, Head and Neck Surgery & Interdisciplinary Center of Vertigo, University Hospital Zurich (USZ), University of Zurich (UZH), Switzerland; 7. University Medicine Halle, Dept. of Otorhinolaryngology, Halle (Saale), Germany; 8. Department of Otolaryngology, Head and Neck Surgery, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

P525

Vertigo and Balance Disorders

Objectives

To compare
- ocular evoked myogenic potentials (oVEMP), and
- mastoid velocity levels

using a Laser Doppler Vibrometer (LDV), with stimulation at the forehead Fz and AFz using three types of bone conduction excitation:

(1) A new bone transducer B250
(2) Minishaker B&K 4810
(3) Tendon Hammer

Background

A new small size prototype transducer (B250) with low frequency emphasis, is proposed as an alternative to the bulky Minishaker B&K4810 (MS) or manually applied impulses with Tendon Hammer (TH) in VEMP testing.

B250
- Static force >10 Newton
- 30 mm contact area, 80 gram
- No power amplifier needed
- No operator needed
- Attached with elastic band

Minishaker
- 30 mm contact area, 1 kg
- Needs power amplifier
- Handheld and aligned by operator

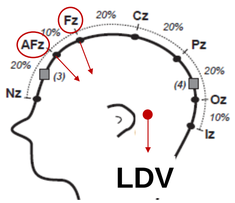
Tendon hammer
- Operator applied impulses
- Force gauge & trigger switch
- incorporated

Methods

We use standard procedures for oVEMP with a condensation stimuli at forehead Fz and AFz, see figure.
The B250 can also be applied to the mastoid using a steel spring, but that will not be investigated here.

oVEMP:
eClipse EP25 platform

B250 and Minishaker stimuli:
250 Hz, 0-1-0, 130-145 dB peakFL



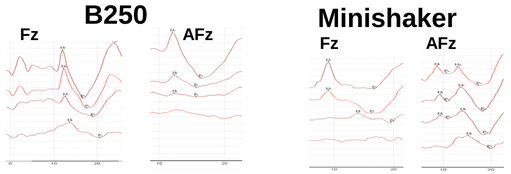
Modified from
Govender and Colebatch 2018

LDV:
- Polytech HLV-1000
- Reflector glued behind the ear.
- Measure perpendicular skin velocity over the mastoid bone.

Results

oVEMP results

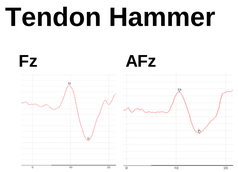
Results from one of the two subjects (S2) are shown



Fz vs AFz with the different stimuli

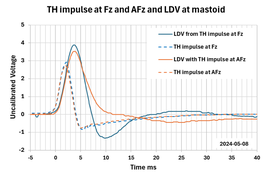
		B250 Fz / AFz	Minishaker Fz / AFz	Tendon Hammer Fz / AFz	
S1	n1	9.3 / 9 *	9.3 / 9.7	9.7 / 10	ms
	p1	11 / 11	12.7 / 13	14.3 / 15	ms
	Ampl	1.3 / 3.1	2.6 / 1.2	9.5 / 9.5	uV
S2	n1	12.3 / 12	9 / 8.7 *	9.7 / 10.7	ms
	p1	16.7 / 16.3	16.7 / 10.7	14.7 / 14.7	ms
	Ampl	14.6 / 12.3	4.5 / 1.1	19.6 / 11.9	uV

* First minor n1-p1 response



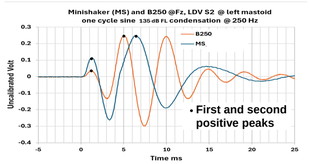
LDV results

Tendon Hammer impulse excitation and LDV response



Excitation impulses at Fz and AFz are very similar as well as the resulting LDV velocity at the mastoid skin surface.

B250 and Minishaker, LDV responses from single cycle 250 Hz



B250 has a resonance at 250 Hz, explaining the ringing after 4 ms when the input signal is off. The B250, and to some extent the Minishaker, has a first smaller peak followed by a second higher positive peak.

In all excitations, a condensation forehead stimuli gives a rarefaction movement of the mastoid bone!

Discussion

- oVEMP results are very similar at Fz and AFz which suggest that AFz can be used for practical reasons (less hair involved, more stable attachment of B250 with headband).
- In some registrations, there is a first minor n1-p1 at around 10 ms followed by a major n'1-p'1 at 12-14 ms (in S1-B250-Fz and S2-Minishaker-AFz). This is assumed to originate from a less pronounced first positive peak with B250/Minishaker.
- LDV results show that a condensation stimuli at the forehead (both Fz and AFz) corresponds to a rarefaction velocity of the mastoid bone, which indeed has been reported to be the main direction of vibration eliciting the oVEMP reflex.

Conclusions

- Results suggest that B250 can replace Minishaker and Tendon Hammer for oVEMP testing with a condensation stimuli at AFz.
- More subjects are needed to confirm results, but the planned clinical study is delayed because of significantly increased regulations under the new MDR as B250 is not CE marked.

More information

For more info and request for evaluation prototypes of the B250 (not yet CE marked) contact:
Bo Håkansson: Mail: boh@chalmers.se, Mob: +46707853294